IOP
MATHEMATICS
GRADES 8 AND 9

A. PROGRAM RATIONALE AND PHILOSOPHY

RATIONALE

In recognition that the needs of both the individual and society may best be served through school experiences designed to meet student needs and abilities, the *Secondary Education in Alberta* policy statement, June 1985, directs that a program be developed for students who have experienced difficulty learning. This program, beginning in Grade 8, is known as the Integrated Occupational Program (IOP) and articulates with a similar program in the senior high school. The policy states that:

> ... the goals of secondary schools are to assist students to . . . become aware of the expectations, and be prepared for the opportunities of the workplace—expectations that will be faced as employees or employers; expectations that will be faced as entrepreneurs or volunteers ... (p. 13)

The policy also states the value of community partnerships in the educational process:

> Opportunities must be provided to involve the [comm]unity in secondary education programs [t]o recognize and support learning [activiti]es which take place outside of [the school. (p. 8)

[...] the policy statement directs that:

> [A C]ertificate of Achievement will be [awarde]d to those students who, because of

their abilities and needs, have taken the Integrated Occupational Program. The Certificate will recognize their achievement in that program. (p. 23)

The Integrated Occupational Program is designed to enable students to:

- become responsible members of society
- develop entry-level vocational abilities
- recognize the need for lifelong learning.

The Integrated Occupational Mathematics Program, Grades 8 and 9, provides for the development of essential concepts, skills and attitudes required for effective computation and problem solving. The program is activity-based, and addresses the need for students to be able to transfer and apply specific mathematical concepts and skills to more generalized situations in everyday life and the world of work. This approach is intended to foster an appreciation of mathematics for its usefulness and relevance, and thus motivate students to participate in the learning process.

Students need to be able to cope with the rapid pace at which change occurs in both home and work environments. A focus on effective strategies for problem solving will assist students to develop thinking skills and solve problems in new and unfamiliar situations. Students also need to understand applications of calculators and computer technologies in everyday situations involving computation and problem solving. Time

IOP Mathematics A.1 (Grades 8 and 9)
(Interim 1992)

IOP
MATHEMATICS
GRADES 8 AND 9

A. PROGRAM RATIONALE AND PHILOSOPHY

RATIONALE

In recognition that the needs of both the individual and society may best be served through school experiences designed to meet student needs and abilities, the *Secondary Education in Alberta* policy statement, June 1985, directs that a program be developed for students who have experienced difficulty learning. This program, beginning in Grade 8, is known as the Integrated Occupational Program (IOP) and articulates with a similar program in the senior high school. The policy states that:

> . . . the goals of secondary schools are to assist students to . . . become aware of the expectations, and be prepared for the opportunities of the workplace—expectations that will be faced as employees or employers; expectations that will be faced as entrepreneurs or volunteers . . . (p. 13)

The policy also states the value of community partnerships in the educational process:

> Opportunities must be provided to involve the community in secondary education programs and to recognize and support learning experiences which take place outside of schools. (p. 8)

In addition, the policy statement directs that:

> The Certificate of Achievement will be awarded to those students who, because of their abilities and needs, have taken the Integrated Occupational Program. The Certificate will recognize their achievement in that program. (p. 23)

The Integrated Occupational Program is designed to enable students to:

- become responsible members of society
- develop entry-level vocational abilities
- recognize the need for lifelong learning.

The Integrated Occupational Mathematics Program, Grades 8 and 9, provides for the development of essential concepts, skills and attitudes required for effective computation and problem solving. The program is activity-based, and addresses the need for students to be able to transfer and apply specific mathematical concepts and skills to more generalized situations in everyday life and the world of work. This approach is intended to foster an appreciation of mathematics for its usefulness and relevance, and thus motivate students to participate in the learning process.

Students need to be able to cope with the rapid pace at which change occurs in both home and work environments. A focus on effective strategies for problem solving will assist students to develop thinking skills and solve problems in new and unfamiliar situations. Students also need to understand applications of calculators and computer technologies in everyday situations involving computation and problem solving. Time

spent learning mathematics can no longer be limited to practising long, repetitive or tedious procedures that are more efficiently accomplished with a calculator. A focus on the use of technology throughout the mathematics program will enable students to use calculators and computers in performing routine tasks more easily replicated by these technologies. The demands of daily living require ability to perform computations using several different methods, including mental arithmetic, estimation, the calculator and paper/pencil. A focus on computational facility and estimation skills will assist students to select and use computational procedures that are appropriate in a variety of practical situations.

Students are often unaware of strategies they may generate and employ to become more efficient in their cognitive functioning. Evidence supports, however, that students with learning difficulties can perform strategically, if taught to do so. Thinking strategies that foster effective behaviours in planning, organizing and self-monitoring are emphasized throughout the program. As students learn to understand and control the outcome of tasks demanded of them, confidence in taking risks and accepting challenges will further their ability to solve problems and make informed decisions in everyday life.

Prescribed content within the Integrated Occupational Mathematics Program, Grades 8 and 9, reflects an emphasis on life skills, and has been determined on the basis of the abilities and needs of students for whom the courses were designed. Nevertheless, the philosophy, goals and directions established in the Integrated Occupational Mathematics Program are consistent with those of other regular program mathematics courses. This continuity will assist students in their transition from a regular program to the IOP, and from the IOP back to a regular program.

PHILOSOPHY

The need to develop programs for exceptional students is based on a fundamental belief about children, as expressed in the government's *Secondary Education in Alberta* policy statement, June 1985 that there should be: "... a respect for the unique nature and worth of each individual." (p. 7)

The Integrated Occupational Program rests on a number of additional beliefs and assumptions about the way children learn, the overall potential of these children and their learning needs in relation to societal demands. These beliefs and assumptions have a tremendous impact on program goals, design and implementation.

There are patterns and predictability to children's learning. However, each student's learning preference and pace is unique, reflecting past experiences. The Integrated Occupational Program is designed to address these differences. Though seen as "exceptional" in their learning needs, these children nonetheless fall within the normal range of learning potential; thus, every effort must be made to offer experiences that provide equitable opportunities to participate in all aspects of life. Inherent in the Integrated Occupational Program is an overriding commitment to prepare students for meaningful participation in our democratic society.

The Integrated Occupational Mathematics Program focuses first and foremost on the needs of the learner. As attitude and self-esteem have powerful influences over learning, the program must foster within each student a positive self-concept and a positive attitude toward learning. The concepts, skills and attitudes addressed within the program must:

- provide meaningful and relevant learning experiences
- be appropriate to student ability
- provide for student success
- enable students to understand and function effectively in their personal environment.

Students vary in the ways they receive, process, recall, apply and communicate information. Each student has a preferred way of approaching learning tasks. Instructional planning should include careful assessment of each student's developmental characteristics, knowledge, skills and preferred way of learning. In order to ensure that individual student needs are being met, instructional plans may often need to be adjusted or modified.

Although students are at various stages of cognitive development, most will continue to use concrete operational thinking. Students will depend upon personal experience and personalized content to link new ideas with prior knowledge. As the process of analysis must be based on tangible experience, learning activities should begin at the concrete level. High emphasis should be placed on experiential learning involving manipulatives and hands-on activities. Specific concepts and skills should be developed after establishing a need for their use through learning activities involving three levels of instructional technique:

- concrete; e.g., use of models
- transitional; e.g., pictorial representation
- formal; e.g., symbolic representation.

Strategies that will assist the learner in progressing from the concrete level of thinking to more abstract thought processes are provided in the program of studies/curriculum guide and corresponding teacher resource manual, available for each IOP course from the Learning Resources Distributing Centre.

An integrated approach suggests the linking together of various mathematical skills and strategies into meaningful activities and applications. Abstract concepts and ideas will take on new meaning and significance to students when applied to daily experiences. Organization of mathematics instruction into "themes" is intended to advance the notion of "holistic" learning, relative to both mathematics and the student. Discrete skill instruction is appropriate when specific deficiencies are noted.

The mathematics program must address the realities of today's society in developing the concepts, skills and attitudes that students will use in everyday life and the world of work. The demands of daily living suggest the program place emphasis on the:

- development of number sense and computational facility
- use of technologies such as the calculator and computer

- application of what is learned to a variety of problem-solving situations within a changing society.

These learning goals suggest a broader context for instruction in mathematics, and provide a focus for learning activities that are suggested throughout the program.

B. GENERAL LEARNER EXPECTATIONS

The Integrated Occupational Mathematics Program is designed to assist students in developing and maintaining:

- positive and realistic self-images

- constructive relationships with others

- positive attitudes toward mathematics and lifelong learning.

Within the Integrated Occupational Mathematics Program, Grades 8 and 9, *students will be expected to*:

- develop the essential concepts, skills and attitudes of mathematics that are required for responsible participation in the home, the school, the community and the workplace

- apply mathematical concepts and skills to daily life and occupational situations that are experienced both inside and outside the mathematics classroom

- develop critical and creative thinking skills, and apply these skills through a problem-solving process to a variety of practical situations

- develop the ability to use technology in its various forms

- develop communication skills that are used when learning mathematics and solving practical problems.

Specific Learner Expectations

Specific learner expectations (learning objectives) have been identified for the Integrated Occupational Mathematics Program, Grades 8 and 9, in the Statement of Content, which follows.
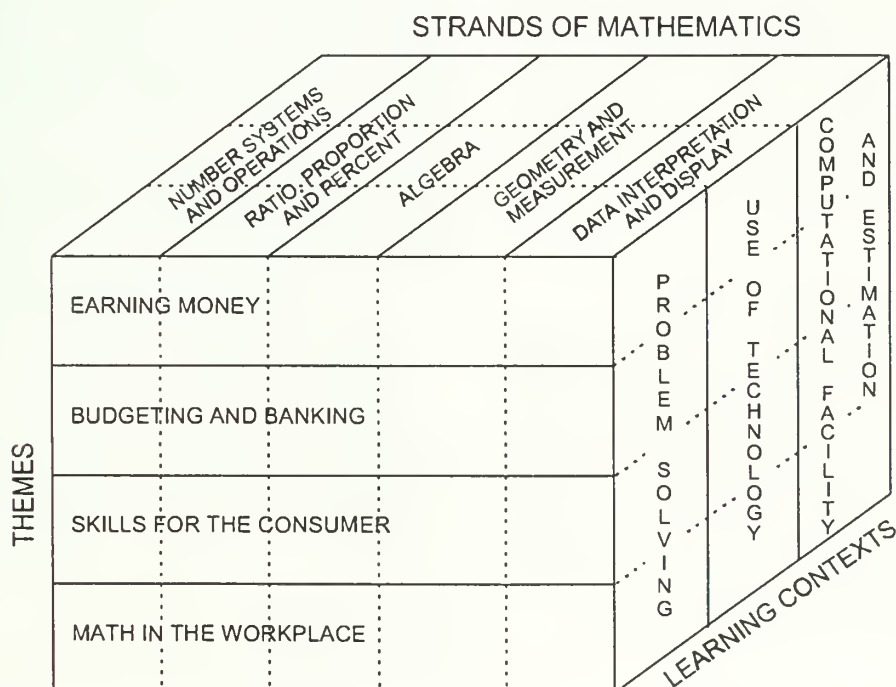
C. STATEMENT OF CONTENT

PROGRAM FRAMEWORK

The framework for the Integrated Occupational Mathematics Program, depicted in the model below, illustrates an integration of program dimensions. Three dimensions that provide a basis for program planning are represented in the model.

- The STRANDS OF MATHEMATICS, represented on the upper face of the model, include concepts, skills and attitudes related to five major content areas. Prescribed content within each of the strands has been determined on the basis of frequent task demands placed upon students in everyday life. The strands represent a consolidation of basic skills, and provide a foundation upon which more difficult concepts and skills may be built in the senior high school years.

- The LEARNING CONTEXTS, represented on the right face of the model, focus attention on strategic behaviours that will enable students to solve problems, use technology and perform computations in daily living. Learning activities that develop these competencies should be provided in concert with activities designed to develop concepts and skills within each of the strands of mathematics.

- The THEMES provide situational and concrete learning experiences where concepts, skills and attitudes related to each of the strands and learning contexts are linked together in meaningful investigations. The themes are placed on the front face of the model to highlight their importance in planning an integrated program. Four themes that address prescribed components within the Integrated Occupational Mathematics Program are provided in the teacher resource manual, available from the Learning Resources Distributing Centre.

INTEGRATED OCCUPATIONAL MATHEMATICS PROGRAM, GRADES 8 AND 9

IOP Mathematics C.1 (Grades 8 and 9)
(Interim 1992)

TIME ALLOCATION

The Integrated Occupational Mathematics Program, Grades 8 and 9, must be offered through a minimum of 100 hours of instruction at each grade level. Schools are encouraged to offer these courses through a time structure that exceeds the 100-hour minimum requirement, if this will help to ensure student success.

COMMUNITY PARTNERSHIPS

Students need to recognize the relevance of computational competence and problem-solving skills in daily life experiences within the home, community and work environments. Within this context, students will be expected to demonstrate competencies that will enable them to:

- apply mathematical concepts and skills to practical situations
- set goals, solve problems and make informed decisions
- begin to prepare for a chosen occupation or career.

Community partnerships are community-based learning experiences that will foster an appreciation of mathematics for its usefulness and relevance, and will assist students to transfer specific concepts and skills to more generalized situations in everyday life and the world of work. Community partnerships include in-school visits, demonstrations, talks, etc., given by community members; and teacher/student observations, job shadowing, work study and work experience activities within the community.

CURRICULAR INTEGRATION

Teachers have traditionally tended to integrate concepts, skills and attitudes from other subject areas into their teaching specialty; however, this tendency has generally been incidental rather than by curricular and instructional design. In contrast, the Integrated Occupational Program is designed specifically to integrate related concepts, skills and attitudes across the curriculum. In addition, teachers in the program are encouraged to adopt integrated planning and teaching strategies.

Suggestions for relating prescribed content within the mathematics program to daily life skills and applications in other subject areas across the curriculum are provided in the program of studies/curriculum guide and corresponding teacher resource manual.

REQUIRED AND ELECTIVE COMPONENTS

The required component of the Integrated Occupational Mathematics Program, Grades 8 and 9, includes the concepts, skills and attitudes that all students must acquire. The learner expectations identified within this document comprise the required component of the mathematics program.

The required component of this mathematics program has been integrated into four themes at each level:

- Managing Your Money
- World of Work
- Using Math at Home
- Travel and Recreation.

These themes are developed in the teacher resource manual, and include a variety of student activities intended to provide suggestions, models and strategies. Although using these themes will ensure coverage of the required component, teachers are encouraged to add, delete and alter activities to meet the abilities, needs and interests of students.

The elective component of the Integrated Occupational Mathematics Program, Grades 8 and 9, permits the teacher to:

- extend or expand upon topics, thus embedding additional concepts, skills and attitudes considered appropriate to student interest and need
- enrich the program by introducing new concepts and activities considered relevant to the student and the local community
- remediate or reinforce concepts, skills and attitudes within the required component.

Students' abilities, interests and needs will largely determine how the elective component will be used. Teachers should assess student performance

on an ongoing basis, and use the elective component of each course to provide individual students with remedial and/or enrichment activities.

Instructional time for the Integrated Occupational Mathematics Program, Grades 8 and 9, should be apportioned:

- 80% Required
- 20% Elective.

PROGRAM SEQUENCES AND TRANSFER POINTS

Students may enter the Integrated Occupational Program at either the Grade 8 or Grade 9 levels. Criteria for determining student eligibility for the Integrated Occupational Program are provided in the current *Guide to Education: ECS to Grade 12 Handbook*.

After one or two years in IOP at the junior high school level, students may transfer to regular programs, or progress in the Integrated Occupational Program at the senior high school level. Decisions regarding course sequences and transfer points throughout junior high school should reflect the achievements, needs and interests of individual students.

Teachers are encouraged to assist students in planning their high school programs. All students should become familiar with the credit requirements for graduation from senior high school, and obligatory courses for the Certificate of Achievement and/or diplomas. Information regarding high school programs and graduation requirements is outlined in the current *Guide to Education: ECS to Grade 12 Handbook*.

SPECIFIC LEARNER EXPECTATIONS

Specific learner expectations for the Integrated Occupational Mathematics Program, Grades 8 and 9, are provided on the pages that follow. Learner expectations that provide meaningful **learning contexts** (i.e., problem solving, use of technology, computational facility and estimation) are followed by learner expectations within five **strands of mathematics**; i.e., number systems and operations; ratio, proportion and per cent; algebra; geometry and measurement; data interpretation and display.

Although the specific learner expectations that follow comprise the required component of each mathematics course, they are not intended to provide a sequenced plan for instruction. Prescribed concepts, skills and attitudes should be appropriately clustered and applied to progressively difficult and/or age-appropriate situations as students advance through junior high school. Teachers are encouraged to organize for instruction in ways that are consistent with the abilities, interests and needs of students, using relevant sections of the program of studies/curriculum guide and teacher resource manual, locally developed themes or a combination of approaches.

Prescribed content for the Integrated Occupational Mathematics Program is developmental through Grades 8 and 9. The Integrated Occupational Mathematics Program, Grade 9, provides opportunities for students to reinforce and extend their understanding of content developed in Grade 8 through more extensive applications, and prescribes new skills related to each of the five strands of mathematics. In cases where specific learner expectations are repeated in Grades 8 and 9, it is expected that teachers will help students to increase in proficiency from grade to grade.

PROBLEM SOLVING

Problem solving is to be integrated throughout all areas of the mathematics program, as learning to solve problems is a major purpose of studying mathematics. *Students* should recognize that problems can be solved in many ways, and *will be expected to* use a variety of strategies that help them to understand problems, develop and carry out a problem-solving plan, and review/apply the results of problem solving. Learning activities that develop problem-solving competencies should be provided in concert with activities designed to develop competencies within each of the strands of mathematics.

Specific Learner Expectations

<u>Grade 8</u>   <u>Grade 9</u>

Attitudes   **Attitudes**

The student will be expected to: *The student will be expected to:*

- display interest and curiosity in problem situations through willingness to ask questions, share observations and ideas, and seek answers
- take risks and display perseverance when solving problems
- appreciate the usefulness of problem-solving skills within the home, the community and the workplace.

Concepts   **Concepts**

The student will be expected to demonstrate an   *The student will be expected to demonstrate an*
understanding that: *understanding that:*

- problems can be routine, requiring only the application of a known procedure/algorithm, or non-routine, where no readily apparent solution, or means to a solution, is evident
- a variety of strategies/skills is useful in understanding and solving mathematical problems.

Skills   **Skills**

The student will be expected to demonstrate an   *The student will be expected to demonstrate an*
ability to: *ability to:*

- apply strategies/skills that are useful in understanding a problem to:
  - read the problem carefully, identifying key words and their meanings
  - interpret information presented in oral,   – interpret tables, charts and graphs
    written or pictorial form
  - talk about the problem and ask questions   – look for patterns in the problem
  - identify given and needed information   – identify given, needed and extraneous
    within the problem   information within the problem
  - use pictures, diagrams or concrete manipulatives to represent the problem
  - internalize the problem by restating it in his or her own words, or by visualizing the problem
                                                     – relate the problem to other problems
                                                       previously encountered

IOP Mathematics C.4 (Grades 8 and 9)
(Interim 1992)

Grade 8	Grade 9

Skills (continued) **Skills** (continued)

- apply strategies/skills that are useful in developing and carrying out a problem-solving plan to:
  - work carefully, explaining work being done and recording findings systematically
  - work in group situations, asking relevant questions and sharing ideas

– sort/classify information given in the problem	– identify and apply patterns and relationships evident within the problem
– guess and check the result (thus proving the guess)	– use experience to make and test predictions about the outcome
– visualize the problem	– organize data into diagrams, charts, tables, graphs or models

  - use positive self-talk statements; e.g., "I can solve this."
  - choose and sequence the operations needed; select appropriate calculating/measuring devices and methods
  - experiment with the problem through the use of concrete manipulatives

– act out or simulate the problem	– look for a simpler/related problem
	– break the problem down into smaller/ component parts

- apply strategies/skills that are useful in reviewing and applying the results of problem solving to:
  - clearly explain the solution/outcome to others in oral or written form
  - check the results and consider whether or not they are sensible/reasonable
  - discuss and compare with others the problem-solving approach that was used

	– suggest other ways of solving the problem
– determine if the problem-solving approach was successful, and if not, how it should be modified	
	– create and solve similar problems.

USE OF TECHNOLOGY

Students will be expected to develop an understanding of the pervasiveness of technology and strategies for harnessing its potential in productive ways. All students should have appropriate calculators available for use throughout the mathematics program. To the extent that computer facilities and equipment are available, *students will be expected to* work independently with prepared software, and use simple programs that have been written for particular purposes. Learning activities that develop competencies related to the use of technology should be provided in concert with activities designed to develop competencies within each of the strands of mathematics.

Specific Learner Expectations

<table>
<tr><td align="center"><u>Grade 8</u></td><td align="center"><u>Grade 9</u></td></tr>
</table>

Attitudes	Attitudes
The student will be expected to:	*The student will be expected to:*

- display a desire and willingness to use a calculator to perform calculations and solve problems
- appreciate the impact of computer technology in everyday and work-related situations.

Concepts	Concepts
The student will be expected to demonstrate an understanding that:	*The student will be expected to demonstrate an understanding that:*

- calculators and computers have influenced the nature of the computational procedures and problem-solving processes that we use
- effective use of calculators and computers requires knowledge of appropriate procedures for their use.

Skills	Skills
The student will be expected to demonstrate an ability to:	*The student will be expected to demonstrate an ability to:*

- identify appropriate and inappropriate uses of the calculator
- clear the display of the calculator and identify/correct entry errors
- use the calculator to perform computations with whole numbers and decimals to:

– identify and use basic functions on the calculator; i.e., $+$, $-$, $\times$, $\div$, $=$, decimal, clear	– identify and use additional functions on the calculator; i.e., %
– enter numbers in correct sequence for calculations involving subtraction and division	
– determine whole number remainders as necessary for division problems	
	– use appropriate techniques to generate sets of multiples for a given number

- read a calculator display to the nearest whole number	- select from calculator display the number of decimal places appropriate to the context of a calculation/problem
- use estimation and mental arithmetic to check the reasonableness of addition and subtraction calculations	- use estimation and mental arithmetic to check the reasonableness of multiplication and division problems involving whole numbers

- identify major parts of a computer and distinguish between hardware and software
- explain how computers get their instructions from a program written to accomplish a specific task
- give examples of the application of computers in performing tasks that require speed, accuracy, repeated operations and the processing of large amounts of data.

COMPUTATIONAL FACILITY AND ESTIMATION

Students will be expected to develop an understanding that there are several ways to perform numerical computations, and that the method chosen will depend upon the situation at hand. All *students will develop* strategies for performing computations through the use of mental arithmetic, paper-and-pencil algorithms, estimation and the calculator. Learning activities that develop computational facility should be provided throughout the mathematics program within the context of real-life situations, and in concert with activities designed to develop competencies within each of the strands of mathematics.

Specific Learner Expectations

Grade 8	Grade 9

Attitudes

The student will be expected to:

Attitudes

The student will be expected to:

- demonstrate awareness of appropriate methods of computation in daily life situations
- appreciate that computational facility can assist in solving everyday problems.

Concepts

The student will be expected to demonstrate an understanding that:

Concepts

The student will be expected to demonstrate an understanding that:

- computation can be performed by a variety of methods, and may include the use of mental arithmetic, paper-and-pencil algorithms, estimation and the calculator
- checking an answer for its reasonableness and accuracy is a fundamental step in the computational process.

Skills

The student will be expected to demonstrate an ability to:

Skills

The student will be expected to demonstrate an ability to:

- select and apply mental arithmetic skills that are based upon:
    - all single-digit operations
    - sequences of operations
    - doubling and halving
    - adding, subtracting, multiplying and dividing by powers of 10
    - rules for divisibility by 2, 5 and 10
    - number patterns, properties and equivalent forms

- generalize number patterns and relationships that arise in practical situations; apply previously acquired strategies to mentally solve whole number, decimal and fraction problems within a wider range of contexts

- use paper-and-pencil algorithms to perform computations with whole numbers, decimals, fractions and per cent within parameters established for the program (see Number Systems and Operations; Ratio, Proportion and Per Cent)
- use the calculator to perform computations with whole numbers, decimals, fractions and per cent within parameters established by the nature of the problem (see Use of Technology)

Grade 8	Grade 9

Skills (continued)

Skills (continued)

- select and apply estimation skills that are based upon:
  - predicting whether a computation will result in a larger or smaller number
  - "trial and improvement" methods
  - forecasting an order of magnitude for the result of a computation; e.g., 10s, 100s, 1 000s.

- apply previously acquired estimation strategies within a wider range of contexts; check to ensure that the results of:
  - addition and subtraction are valid
  - multiplication and division involving whole numbers are of the correct order.

NUMBER SYSTEMS AND OPERATIONS

Students will be expected to demonstrate knowledge of the basic properties of whole numbers, decimals, fractions and integers, and of appropriate strategies for performing operations with these numbers. Instructional activities should provide opportunities for students to build concepts and demonstrate understandings through the use of concrete models and materials, and within the context of real-life situations.

Specific Learner Expectations

Grade 8	Grade 9

Attitudes

Attitudes

The student will be expected to:

The student will be expected to:

- display curiosity and be open to new ideas when investigating the use of different computational procedures
- appreciate that knowledge of appropriate notation and number properties is essential to the use of number systems and operations.

Concepts

Concepts

The student will be expected to demonstrate an understanding that:

The student will be expected to demonstrate an understanding that:

- performing operations of addition, subtraction, multiplication and division with whole numbers, decimals and fractions involves the application of certain processes
- computation with whole numbers, decimals and fractions may involve the use of paper-and-pencil algorithms, estimation, mental arithmetic and/or the calculator.

Grade 8	Grade 9

Skills

Whole Numbers

The student will be expected to demonstrate an ability to:

Skills

Whole Numbers

The student will be expected to demonstrate an ability to:

- identify place value, quantify and order numbers to one hundred thousand in applications
- read and write whole numbers in numeric or word form to one hundred thousand in context
- describe the first digit as the most important in indicating the size of a number, and approximate numbers to nearest 10, 100, 1 000

• count by multiples of 2, 3, 4, 5, 6, 10 and 12	• use a calculator to generate a set of multiples for a given number
	• determine the lowest common multiple for pairs of numbers less than 10

- add and subtract whole numbers (limit for paper-and-pencil computation: numbers less than 10 000)
- recall multiplication facts up to 10×10, and use them in multiplication and division problems

	• identify prime numbers up to 50, and express numbers up to 50 as the product of prime factors
	• determine the greatest common factor for pairs of numbers less than 50
• multiply and divide whole numbers (limit for paper-and-pencil computation: numbers less than 1 000 by numbers less than 10)	• multiply and divide whole numbers (limit for paper-and-pencil computation: numbers less than 1 000 by numbers less than 100)

- apply the properties of numbers and operations to computational activities; e.g., properties of zero and one, commutative/associative/distributive properties, order of operations.

Decimals

The student will be expected to demonstrate an ability to:

Decimals

The student will be expected to demonstrate an ability to:

- identify place value, quantify and order numbers to thousandths in applications
- read and write decimals in numeric or word form to thousandths in context
- round decimals to the nearest whole number, tenth and hundredth
- add and subtract decimals (limit for paper-and-pencil computation: numbers to hundredths)

• multiply decimals (limit for paper-and-pencil computation: numbers that yield products to thousandths, using one-digit multipliers)	• multiply decimals (limit for paper-and-pencil computation: numbers that yield products to thousandths, using one- or two-digit multipliers)
• divide decimals (limit for paper-and-pencil computation: numbers having three digits or less, by one-digit whole number divisors; dividend may have 0, 1 or 2 decimal places).	• divide decimals (limit for paper-and-pencil computation: numbers having three digits or less by one- or two-digit whole number divisors; dividend may have 0, 1 or 2 decimal places).

Grade 8	Grade 9

Skills (continued)

Fractions

Skills (continued)

Fractions

Students will be expected to develop an understanding of fractions through the use of real-life models and concrete manipulatives. Instructional emphasis should be placed on "families" of fractions (sixths, eighths, tenths), and fractions having denominators of 2, 3, 4, 5, 8 and 10.

The student will be expected to demonstrate an ability to:

The student will be expected to demonstrate an ability to:

- illustrate the use of fractions in describing part of a whole, group or point on a number line
- illustrate and explain proper/improper/mixed fractions through the use of objects, pictures and diagrams
- use a number line to illustrate the relationship between whole numbers, decimals and fractions
- compare and order proper/improper/mixed fractions in applications
- identify and express proper/improper/mixed fractions in basic form

- relate fractions to division, and convert fractions into decimal equivalents using a calculator
- recall decimal equivalents for frequently used fractions; i.e., one half, quarters, tenths
- recognize "families" of fractions (sixths, eighths, tenths), and determine common denominators for fractions within families

- demonstrate addition and subtraction of proper/mixed fractions with like denominators through the use of objects, pictures and diagrams
- write number sentences to describe addition and subtraction of fractions with like denominators.

- demonstrate addition and subtraction of proper/mixed fractions with denominators of 2, 3, 4, 5, 8 and 10 through the use of objects, pictures and diagrams
- write number sentences to describe addition and subtraction of fractions with denominators of 2, 3, 4, 5, 8 and 10
- demonstrate multiplication and division of proper/mixed fractions by whole numbers through the use of concrete manipulatives
- write number sentences to describe multiplication and division of proper/mixed fractions by whole numbers.

Grade 8	Grade 9
Skills (continued)	**Skills** (continued)

Integers

The student will be expected to demonstrate an ability to:

- illustrate applications of integers in practical situations and interpret related vocabulary; i.e., positive, negative, plus, minus, above, below, gain, loss
- compare and order integers on the number line and in applications
- demonstrate addition of pairs of integers between –25 and +25 through concrete manipulation/diagrammatic representation
- write number sentences to describe addition of integers undertaken in the concrete mode.

RATIO, PROPORTION AND PER CENT

Students will be expected to demonstrate an understanding of ratio, proportion and per cent at the concrete level through the use of objects, models and diagrams. Instructional activities should focus attention on everyday applications of ratio, proportion and per cent, and a strategy for solving related problems.

Specific Learner Expectations

Grade 8	Grade 9
Attitudes	**Attitudes**
The student will be expected to:	*The student will be expected to:*

- display an awareness that ratio, proportion and per cent have applications in practical situations
- appreciate that computational facility with ratios, proportions and per cents can assist in solving everyday problems.

Concepts	**Concepts**
The student will be expected to demonstrate an understanding that:	*The student will be expected to demonstrate an understanding that:*

- ratios represent a comparison of the relative sizes of two quantities
- proportions are statements that are made about equivalent ratios
- per cent is a special kind of ratio in which a quantity is always compared to 100.

Skills	**Skills**
The student will be expected to demonstrate an ability to:	*The student will be expected to demonstrate an ability to:*
- use concrete manipulation to construct ratios in the form a:b, a to b and a/b	- compare two quantities in the same unit by writing ratios in the form of a:b, a to b and a/b

Skills (continued)   **Skills** (continued)

- generate equivalent ratios using single-digit whole number constants, and verify the equivalence of two ratios using common multiples or factors; e.g., $\dfrac{14\ (\div 2)}{6\ (\div 2)} = \dfrac{7}{3}$

- identify "rates" as ratios showing comparison of two numbers with different units; e.g., 90 km/2h, 3 items for $1

- identify proportions as statements about equivalent ratios, and write proportions that describe practical problem situations

- write proportions that describe practical problem situations involving rates

- determine the value of the missing component in a proportion using the common factor/multiple method; e.g., $\dfrac{3\ (\times 25)}{4\ (\times 25)} = \dfrac{?}{100}$

- determine the value of the missing component in a proportion involving rates

- illustrate the meaning of per cent as a ratio indicating parts out of 100.

- express whole number per cents as ratios and decimals
- express ratios as per cents and decimals and vice versa (limit for paper-and-pencil computation: $\dfrac{a}{b} = \dfrac{?}{100}$ where b=2, 4, 5, 10, 20, 25 or 50)
- recall fraction, decimal and per cent equivalents for one half, quarters and tenths
- determine other fraction, decimal and per cent equivalents through the use of the calculator
- calculate/estimate a per cent of a number in practical applications.

ALGEBRA

This strand focuses attention on the use of patterns, relationships and logical thinking skills to make predictions and solve problems. *Students will be expected to* generalize arithmetical patterns, relationships and sequences that are present in concrete situations, and write expressions/equations that describe the patterns and relationships they discover. *Students will use* substitution and simple equation-solving strategies to solve practical problems involving familiar number patterns and relationships.

Specific Learner Expectations

Attitudes   **Attitudes**

The student will be expected to: *The student will be expected to:*

- display an awareness that in many practical situations one attribute changes as another changes
- appreciate that expressions, formulas and tables can describe practical situations and are often useful in making predictions.

Grade 8	Grade 9

Concepts

The student will be expected to demonstrate an understanding that:

- arithmetical patterns and relationships are present in a variety of practical everyday situations and are useful for drawing conclusions and making predictions
- algebraic symbols can be used to write expressions/formulas/linear equations that describe arithmetical patterns and relationships.

Skills

The student will be expected to demonstrate an ability to:

Grade 8	Grade 9
copy, continue and devise repeating patterns represented by objects, manipulatives or numbers	generalize number patterns that arise in practical situations and predict subsequent numbers where appropriate
follow simple sets of instructions to generate number sequences	determine rules for generating a number sequence

- distinguish between the use of variables and constants, and use variables to describe concrete situations; e.g., number of coins in a jar

Grade 8	Grade 9
interpret mathematical expressions that describe relationships in practical situations; e.g., if the regular price of an item is reduced by \$5, the sale price could be represented as $R - 5$	write mathematical expressions that describe relationships in practical situations
interpret formulas and complete tables that describe relationships in practical situations; e.g., if each person at a party eats three hot dogs, the relationship between the number of hot dogs and the number of people can be described as $H = 3 \times P$	write simple formulas and linear equations that describe relationships in practical situations

- perform substitution into formulas as required to determine outcomes/solutions to routine problems
- use concrete manipulatives to demonstrate the concept of equality
- use estimation and guess/check strategies to solve simple linear equations that describe practical situations;

$$e.g., \quad x + a = b$$
$$ax = b$$
$$ax + b = c$$
$$x/a = b/c$$

- verify solutions to linear equations by substitution.

GEOMETRY AND MEASUREMENT

This strand focuses attention on developing spatial and visualization skills, and an understanding of how measures are used to quantify and interpret the world. *Students will investigate* the attributes and properties of familiar one-, two- and three-dimensional geometric figures, and apply related patterns and relationships in solving practical problems. *Students will* also estimate and measure length, area, mass, capacity, time, temperature and angle within the context of everyday applications and problem solving.

It is the policy of Alberta Education that SI units be the principal system of measurement in the curriculum of the schools in the province. The study of specific imperial units should be related only to those that are relevant to student needs (as indicated by the demands of the workplace/community partnership sites) and should be kept to a minimum.

Specific Learner Expectations

Grade 8

Grade 9

Attitudes

The student will be expected to:

Attitudes

The student will be expected to:

- develop an awareness of geometric pattern and form present in the environment
- appreciate that geometry and measurement are useful in describing aspects of the physical world.

Concepts

The student will be expected to demonstrate an understanding that:

Concepts

The student will be expected to demonstrate an understanding that:

- there are basic concepts, patterns and relationships associated with one-, two- and three-dimensional geometric figures
- the selection of units and tools of measurement must always be based upon the physical attributes of the object being measured
- estimation and measurement are iterative, comparative and approximate in nature
- geometry and measurement contribute to the problem-solving process and have application in activities we engage in as citizen, consumer and worker.

Skills

Geometry

The student will be expected to demonstrate an ability to:

Skills

Geometry

The student will be expected to demonstrate an ability to:

- identify, sketch and model horizontal, vertical, perpendicular, parallel and intersecting lines occurring in the environment
- identify common and distinguishing properties of basic two-dimensional figures, including the rectangle, square, triangle and circle

- explain and use properties associated with horizontal, vertical, perpendicular, parallel and intersecting lines
- identify common and distinguishing properties of two-dimensional figures, including the parallelogram, hexagon and octagon

Grade 8	Grade 9

Skills

Geometry (continued)

- construct rectangles, squares, triangles and circles according to given specifications, and using appropriate tools; i.e., protractor, compass, straightedge, ruler, computer

- identify distinguishing characteristics of basic three-dimensional figures, including the rectangular prism, cube and cylinder.

Skills

Geometry (continued)

- construct parallelograms, hexagons and octagons according to given specifications, and using appropriate tools
- explain the relationship between the radius and diameter of a circle, and draw circles when given either radius or diameter
- create two-dimensional geometric patterns and designs, using tools appropriate to the task; i.e., straightedge, compass, ruler, protractor, mira, computer
- construct models of basic three-dimensional figures, including the rectangular prism, cube and cylinder.

Length

The student will be expected to demonstrate an ability to:

- identify common metric units of length (i.e., mm, cm, m, km) and their application

Length

The student will be expected to demonstrate an ability to:

- choose and apply appropriate metric units of length (i.e., mm, cm, m, km) in a variety of situations

- make sensible estimates of length, based on familiar units, in relation to a range of everyday phenomena

- estimate and directly measure length, using appropriate units and measuring instruments for the task
- interpret numbers on a range of measuring instruments
- explain the relationships among mm, cm and m, and between m and km
- illustrate the idea of perimeter by using concrete objects
- demonstrate, other than by using a formula, ways of finding the perimeter of figures bounded by line segments.

- estimate and directly measure length, choosing and maintaining a degree of accuracy appropriate for a particular purpose
- explain why length expressed to a given unit is in possible error of half a unit
- convert among mm, cm and m, and between m and km
- explain applications of perimeter in familiar problem-solving situations
- demonstrate, with and without using a formula, ways of finding the perimeter of rectangles, squares and triangles.

Grade 8	Grade 9

Skills (continued)

Skills (continued)

Area

The student will be expected to demonstrate an ability to:

- illustrate the idea of area, identifying common metric units (i.e., cm^2, m^2) and their application in problem situations
- use concrete objects to approximate the area of two-dimensional geometric figures
- demonstrate, with and without using a formula, ways of finding the area of rectangles and squares
- estimate and calculate the area of rectangles and squares, choosing units and strategies appropriate to the situation.

Mass

The student will be expected to demonstrate an ability to:

Grade 8:

- identify common metric units of mass (i.e., g, kg, t) and their application
- make sensible estimates of mass, based on familiar units, in relation to a range of everyday phenomena
- estimate and measure mass, using appropriate units and measuring instruments for the task
- interpret numbers on a range of measuring instruments
- explain the relationships between g and kg, and between kg and t.

Grade 9:

The student will be expected to demonstrate an ability to:

- choose and apply appropriate metric units of mass (i.e., g, kg, t) in a variety of situations
- estimate and measure mass, choosing and maintaining a degree of accuracy appropriate for a particular purpose
- explain why mass expressed to a given unit is in possible error of half a unit
- convert between g and kg, and between kg and t.

Capacity

The student will be expected to demonstrate an ability to:

Grade 8:

- identify common metric units of capacity (i.e., mL, L) and their application
- make sensible estimates of capacity based on familiar units, in relation to a range of everyday phenomena
- estimate and measure capacity, using appropriate units and measuring instruments for the task
- interpret numbers on a range of measuring instruments
- explain the relationship between mL and L.

Grade 9:

The student will be expected to demonstrate an ability to:

- choose and apply appropriate metric units of capacity (i.e., mL, L) in a variety of situations
- estimate and measure capacity, choosing and maintaining a degree of accuracy appropriate for a particular purpose
- explain why capacity expressed to a given unit is in possible error of half a unit
- convert between mL and L.

Grade 8	Grade 9

Skills (continued)

Skills (continued)

Time

Time

The student will be expected to demonstrate an ability to:

The student will be expected to demonstrate an ability to:

- use a calendar, and explain the relationship among days, weeks, months and years

- convert between days, weeks, months and years in problem situations

- use accepted standards for numeric dating in consumer and wage earner situations
- make sensible estimates of time based on familiar units and in relation to a range of everyday phenomena
- estimate, measure and record time on the 12-hour and 24-hour clocks, using traditional and digital time pieces
- explain the relationship between hours and minutes, and between minutes and seconds.

- convert between hours and minutes, and between minutes and seconds
- add and subtract hours and minutes in applications.

Temperature

The student will be expected to demonstrate an ability to:

- estimate, read and record temperature on the Celsius scale
- recall important temperatures on the Celsius scale; i.e., boiling/freezing point of water, normal room/body temperature
- determine temperature change, including changes from below zero to above zero.

Angle

The student will be expected to demonstrate an ability to:

- identify an angle and the degree as a unit of measure
- identify and estimate angles of 45°, 90°, 180° and 360°
- use a protractor to measure and draw angles from 0° to 180° in practical situations.

DATA INTERPRETATION AND DISPLAY

> We live in a society in which we are confronted daily with quantitative information. *Students will be expected to* interpret, collect, organize and display numerical data in order to predict probable outcomes and make informed decisions in practical situations. Instructional activities should assist students to think consistently about arguments, and justify their thinking with numerical information.

Specific Learner Expectations

<u>Grade 8</u>

<u>Grade 9</u>

Attitudes

Attitudes

The student will be expected to:

The student will be expected to:

- display an awareness that throughout life many decisions are based on numerical data
- appreciate that individuals must often interpret and evaluate numerical data in order to predict probable outcomes regarding health, employment and financial matters.

Concepts

Concepts

The student will be expected to demonstrate an understanding that:

The student will be expected to demonstrate an understanding that:

- statistical measures are useful in summarizing large quantities of numerical data, in communicating ideas and in predicting probable outcomes of actions
- tables, charts and graphs can be used to collect, organize and communicate numerical data
- data collected from a sample must be organized and analyzed in order that valid inferences can be drawn and predictions made.

Skills

Skills

The student will be expected to demonstrate an ability to:

The student will be expected to demonstrate an ability to:

- identify practical situations in which numerical data and statistical measures are used to predict the outcome of an event or action

- extract and interpret specific pieces of information from lists, tables and charts
- collect and record data using tally sheets and frequency tables
- use tables and charts to sort, group and order numerical data according to specified criteria

- identify and demonstrate situations in which the probability of an event occurring is likely, unlikely, equally likely, certain and impossible
- use tables, charts and lists to organize all possible outcomes of an event
- make predictions based upon patterns and relationships evident in lists, tables and charts
- design a data collection sheet, and use it to record a set of data leading to a frequency table
- specify an issue for which numerical data is required; design and use an observation sheet to collect data; use tables and charts to collate and analyze results

Grade 8	Grade 9

Skills (continued)

Skills (continued)

- interpret and calculate the arithmetical average in practical situations
- read and interpret information presented in pictographs, bar graphs and line graphs.
- display data by constructing pictographs, bar graphs and line graphs
- read and interpret information presented in circle graphs
- make predictions based upon information presented in graphs
- demonstrate situations in which graphs may provide misleading information or distort the "true" picture.